SUBJECT: Procedures for Estimating Reclamation Costs for Conventional and In Situ Uranium Recovery Facilities

I. Introduction

The licensing of uranium recovery facilities is addressed in the Texas Natural Resource Conservation Commission (TNRCC) radiation rules, 30 Texas Administrative Code (TAC) Section 336.1(7), which adopts by reference Part 43 of the Texas Regulations for Control of Radiation (TRCR) of the Texas Department of Health. Section 43.60 of the TRCR requires the licensee to provide financial security to cover the costs associated with the decontamination, decommissioning, restoration, and reclamation of buildings and the site. The amount of funds to be ensured by the financial security requirement is based on cost estimate plans approved by the Executive Director. The factors given in this document present general guidance on those items which should be included in the licensee's cost estimates so the Executive Director can evaluate and verify the adequacy of the estimates.

All estimates should give the year upon which they are based and should be site specific. Costs should be based on independent contractors performing all decontamination, decommissioning, restoration, and reclamation. In addition to the costs itemized in Sections II-VI, costs associated with engineering services, chemical tests, and radiological surveys or analyses should be included. Increases in costs due to inflation should be addressed for those activities which take several years to complete. Cost estimates should not include any possible resale value of used equipment, facilities, etc.

For cost estimates involving volumes of contaminated soil to be removed, the U.S. Environmental Protection Agency standard for active uranium mill sites, 40 Code of Federal Regulations Part 192, "Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites," can be used as a guide for

limits to which reclamation should be achieved. For radium-226, this would be the removal of soil containing an average concentration greater than 5 pCi/g within the 15 cm surface layer and 15 pCi/g averaged over 15 cm thick layers of soil more than 15 cm below the surface. These concentrations are averaged over 100 m^2 surface area.

If assumptions other than those presented here are used for cost estimate plans, the assumptions should be justified. Site-specific data on contamination levels should be used to change the assumptions used in Sections II-VI.

II. Mill Sites: Factors for Estimating Reclamation Costs

A. Items to be Included in Cost Estimate:

1. Removal and disposal of all structures, including concrete pads, process plant, offices, laboratory, and other associated buildings.

2. Removal and disposal of contaminated soil from the area under the process plant pad.

3. Removal and disposal of contaminated soil at the mill/office site, on roads, or other licensed areas.

4. Removal and disposal of contaminated soil from the area under the ore pad at conventional facilities.

5. Removal of uncontaminated roads, caliche base, parking lots, etc., if required.

6. Leveling or contouring.

7. Soil preparation and revegetation.

B. Assumptions:

1. Concrete pads are 1 ft thick under the process plant and 4 inches thick under other structures.

2. A minimum of 0.5 ft of soil is contaminated under the process plant pad.

3. A minimum of 1 ft of soil is contaminated under the ore pad.

4. The average density of the soil is 100 lb/cu ft.

5. The density of concrete is 180 lb/cu ft.

6. Sufficient topsoil is present except in the area under the process plant pad. In this area, 0.5 ft of topsoil will be added.

7. No additional cost is incurred in offsite hauling or disposing of uncontaminated caliche soil.

C. Data to Submit:

1. a. Process plant area in square feet, including the extraction circuit, yellowcake slurry storage area, yellowcake dryer, etc. Areas of any ore pads.

   b. Areas and thicknesses of concrete pads under the process plant and under the office, laboratory, and other buildings.

   c. Total mill site acreage to be reclaimed, including the process plant, ore pad, office, laboratory, other buildings, parking lots, roads, etc.

   d. Any available data on the locations, surface areas, and depths of contaminated portions of the mill site.

   e. A description of the thickness and location of any roads, parking lots, and any caliche base placed over the mill site during construction. A description of any plans to remove and dispose of these materials upon decommissioning.

2. Time frame for completing each phase of reclamation.

3. Volume of contaminated soil to be removed.

4. Types, numbers, and costs of equipment to be used in removal of contaminated soil.

5. Hauling distance, hauling cost, and hauling equipment for contaminated soil.

6. Disposal costs for contaminated soil.

7. Costs for removal and disposal of buildings, the process plant, and associated equipment.

8. Costs for removal and disposal of contaminated and uncontaminated concrete.

9. Costs for removal of uncontaminated road material or caliche, if required.

10. Costs of topsoil, hauling, placement, and leveling or contouring.

11. Costs for soil preparation and revegetation.

12. Costs for control of fugitive dust.

III. Tailings Ponds: Factors for Estimating Reclamation Costs

A. Items to be Included in Cost Estimate:

1. Installation and operation of a spray or other system to enhance evaporation or other methods of dewatering.

2. Chemical or other treatment of the tailings to promote stabilization and immobilization of the tailings material.

3. Wetting and/or treatment of tailings to minimize blowing and dusting, as required.

4. Backfilling with at least 3 m of uncontaminated earth cover, including a layer of topsoil that will support the growth of vegetation. If less cover is proposed, the licensee must provide information to show that the cover will achieve the technical requirements of 30 TAC Section 336.1(7), TRCR Section 43.90.

5. Leveling and contouring the embankment as required to minimize erosion and to provide final slopes that do not exceed five horizontal to one vertical (5H:1V). If steeper slopes are proposed, the licensee should provide information to show that the proposed slopes will be equally resistant to erosion as 5H:1V slopes. Compensating factors and conditions should be identified.

6. Soil preparation and revegetation to establish a full self-sustaining vegetative cover.

7. Establishment of a rock cover to minimize erosion on the slopes when vegetation growth is not likely due to climatic conditions. Rock cover (riprap) should also be provided in areas where surface runoff from the slopes might be directed.

B. Assumptions:

Uncontaminated soil for backfilling and topsoil are stockpiled near the tailings pond.

C. Data to Submit:

1. Surface acreage and dimensions of the tailings pond (including the perimeter), steepness of existing slopes, height of the embankment crest above ground level, depth of the tailings, the distance between the crest of the embankment and the surface of the tailings.

2. Time frame for completing each phase of reclamation.

3. Method to be used to enhance evaporation or dewatering of tailings; types of equipment and costs for installation and operation.

4. Methods and costs of chemical or other treatment of tailings for stabilization, not including the cover.

5. Any additional costs that may be required to control blowing and dusting tailings.

6. Volume of cover material and topsoil needed (allowing for shrinkage) and the costs of hauling and placement. The volume of cover material should include that required to construct the final slopes.

7. The volume of embankment material between the crest of the embankment and the surface of the tailings may be considered as cover material. This volume of embankment material may be included in the total volume of cover material required.

8. Costs of cutting down the embankment, leveling, and contouring to construct the required final slopes.

9. Costs of soil preparation and revegetation, based on the acreage of the pond and final slopes.

10. Cost of any rock cover (riprap).

IV. Evaporation or Waste Retention Ponds: Factors for Estimating Reclamation Costs

A. Items to be Included in Cost Estimate:

1. Removal and disposal of fluid and/or sediments, liner, contaminated soil below the liner, and associated equipment, i.e., pumps, pipes, etc.

2. Backfilling with uncontaminated material, including a layer of topsoil that will support the growth of vegetation.

3. Leveling or contouring.

4. Soil preparation and revegetation.

B. Assumptions:

1. Soil extending 0.5 ft below the liner is contaminated. At some facilities, the depth of contamination may be greater, requiring removal of a greater volume of soil.

2. The average density of the soil is 100 lb/cu ft.

3. Uncontaminated soil for backfilling and topsoil are stockpiled near the pond.

C. Data to Submit:

1. For each evaporation or waste retention pond, the surface acreage, acreage of the bottom of the pond, maxiumum depth, freeboard, and total capacity (including freeboard).

2. Time frame for completing each phase of reclamation.

3. Types and volumes of contaminated soil, fluid, sediment, materials, and equipment to be removed.

4. Types, numbers, and costs of equipment to be used in removal of contaminated soil.

5. Hauling distance, hauling cost, and hauling equipment for contaminated soil, materials, and equipment.

6. Disposal costs, including costs at the receiving facility. If a deep waste disposal well is used for fluid disposal, the cost of operating it should be included.

7. Volume of fill material needed (allowing for shrinkage); costs of fill material, topsoil, hauling, placement, and leveling or contouring.

8. Costs of soil preparation and revegetation, based on the surface level acreage of the pond.

V. Wellfields at In Situ Uranium Recovery Facilities: Factors for Estimating Reclamation Costs

A. Items to be Included in Cost Estimate:

1. Dismantling, removing, and disposing of pipe, wellheads, and related equipment.

2. Dismantling, removing, and disposing of wellfield surge tanks or plant satellite equipment.

3. Removal and disposal of contaminated soil from the wellfield.

4. Removal of uncontaminated roads or caliche base, if required.

5. Leveling or contouring.

6. Soil preparation and revegetation.

B. Assumptions:

1. The volume of contaminated soil to be removed, if averaged over the entire area of the wellfield, would occupy a depth of 2 cm or 0.8 inch.

2. The average density of the soil or caliche is 100 lb/cu ft.

3. Remaining topsoil is adequate for reclamation.

4. No additional cost is incurred in offsite hauling or disposing of uncontaminated caliche soil.

C. Data to Submit:

1. a. Acreage of all wellfields (production areas) currently in production or previously in production and all disposal well sites. Acreage of any additional wellfields or pattern areas that are expected to be in production within one year.

   b. Any available data on the locations, surface areas, and depths of contaminated portions of the wellfields.

   c. A description of the thickness and location of any roads and any caliche base placed over the wellfields during construction. A description of any plans to remove and dispose of the roads or caliche upon decommissioning.

2. Time frame for completing each phase of reclamation.

3. Volume of contaminated soil to be removed.

4. Types, numbers, and costs of equipment to be used in removal of contaminated soil.

5. Hauling distance, hauling cost, and hauling equipment for contaminated soil.

6. Disposal costs for contaminated soil.

7. Costs for leveling or contouring.

8. Costs for removal, hauling, and disposal of pipes, pumps, and other equipment.

9. Costs for removal of uncontaminated road material or caliche, if required.

10. Costs for soil preparation and revegetation.

11. Costs for control of fugitive dust.

VI. <u>In Situ Uranium Recovery Facilities: Factors for Estimating Groundwater Restoration Costs</u>

A. Items to be Included in Cost Estimate:

1. Restoration of production zone groundwater radiological quality at least to levels prescribed by the TNRCC license, permit, or other authorization.

2. Decontamination and/or disposal of restoration-associated surface equipment.

3. Proper disposal of restoration-generated byproduct materials.

B. Assumptions:

1. Achievement of restoration is verified according to sampling procedures specified by the Executive Director.

2. A production area pore volume is defined by:

PV = CATP, where

PV = pore volume in gallons
A = area of production area + 10%
T = average contacted thickness of production zone
P = average production zone porosity, and
C = conversion constant as appropriate to convert volume to gallons.

3. Estimated costs do not include credits for any capital generated from the use of restoration byproduct materials.

4. When restoration plans include discharge or use of restoration-generated byproduct materials in projects requiring additional state authorization (new permit, license, etc.) and proper authorization has not been granted, two estimates should be provided: one assuming the proposed project is authorized and the other assuming it is rejected.

C. Data to Submit:

1. For each production area:

a. Area in acres or square feet.

b. Average porosity of production zone.

c. Average contacted thickness of production zone.

d. Volume of one pore volume as defined in Section VI (B)(2) above.

e. Number of pore volumes required for restoration.

f. Number of pore volumes already pumped.

g. Estimated time required to achieve restoration.

h. General chemical nature of mining lixiviant.

i. Labor costs.

j. Cost of monitor well sampling program.

k. Cost of chemicals used in treatment.

l. Initial cost of additional special equipment (R/O units, electrodialysis units, etc.)

m. Cost of equipment replacement and maintenance.

n. Power consumption cost.

2. General:

a. Documentation supporting the estimated number of pore volumes required to achieve restoration.

b. Description of restoration procedures.

c. Anticipated sales or uses of restoration-generated byproduct materials.

VII. For More Information

This guidance is issued to assist TNRCC licensees and applicants in implementing and complying with specific parts of the radiation rules (30 TAC Chapter 336). Methods other than those presented in this guide may be proposed by the licensee or applicant for approval. For assistance with any questions, please contact the UIC, Uranium, and Radioactive Waste Section, MC-131, Texas Natural Resource Conservation Commission, P.O. Box 13087, Austin, Texas 78711-3087, telephone number (512) 239-6065.